CLAIMS

What is claimed is:

1. A lithium secondary battery, comprising:

a positive electrode including a material that is capable of reversible intercalation/deintercalation of lithium ions as a positive active material;

a negative electrode including a lithium metal, a lithium-containing alloy, a material that is capable of reversible intercalation/deintercalation of lithium ions as a negative active material or or a material that is capable of reversibly forming a lithium-containing compound;

a separator interposed between the positive and negative electrodes; and

an electrolyte on the separator, wherein the electrolyte includes a non-aqueous organic solvent, a lithium salt, and a linear polymer having P=O bonds.

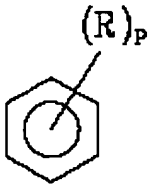
2. The lithium secondary battery according to claim 1, wherein the non-aqueous organic solvent comprises at least one selected from the group consisting of a carbonate, an ester, an ether, and a ketone.

3. The lithium secondary battery according to claim 1, wherein the non-aqueous organic solvent comprises a carbonate selected from the group consisting of dimethyl carbonate (DMC), diethyl carbonate (DEC), dipropyl carbonate (DPC), methylpropyl carbonate (MPC), ethylpropyl carbonate (EPC), methylethyl carbonate (MEC), ethylene carbonate (EC), propylene carbonate (PC), and butylene carbonate (BC).

4. The lithium secondary battery according to claim 1, wherein the non-aqueous organic solvent comprises a mixed solvent of a cyclic carbonate and a linear carbonate.

5. The lithium battery according to claim 1, wherein the non-aqueous organic solvent comprises a mixed solvent of a carbonate solvent and an aromatic hydrocarbon solvent.

6. The lithium battery according to claim 5, wherein the aromatic hydrocarbon solvent is a compound of Formula (1):



where R is a hydrogen, halogen, or a C_1 to C_{10} alkyl, and p is an integer of 1 to about 6.

7. The lithium secondary battery according to claim 6, wherein the aromatic hydrocarbon solvent is at least one selected from the group consisting of benzene, fluorobenzene, toluene, fluorotoluene, trifluorotoluene, xylene, and a mixture thereof.

8. The lithium secondary battery according to claim 5, wherein the carbonate solvent and the aromatic hydrocarbon solvent are mixed in a volume ratio ranging from about 1:1 to about 30:1 carbonate solvent to aromatic hydrocarbon solvent.

9. The lithium secondary battery according to claim 1, wherein the lithium salt is at least one selected from the group consisting of $LiPF_6$, $LiBF_4$, $LiSbF_6$, $LiAsF_6$, $LiClO_4$, $LiCF_3SO_3$, $Li(CF_3SO_2)_2N$, $LiC_4F_9SO_3$, $LiSbF_6$, $LiAlO_4$, $LiAlCl_4$, $LiN(C_xF_{2x+1}SO_2)(C_yF_{2y+1}SO_2)$ (wherein x and y are natural numbers), LiCl, and LiI.

10. The lithium secondary battery according to claim 9, wherein the lithium salt is used in a concentration ranging from about 0.6 to about 2.0 M.

11. The lithium secondary battery according to claim 1, wherein the linear polymer having P=O bonds is formed by polymerizing a phosphonate compound with a polymerizable functional unsaturated hydrocarbon group.

12. The lithium secondary battery according to claim 11, wherein the phosphonate compound with the unsaturated hydrocarbon group is at least one selected from the group consisting of diethyl vinyl phosphonate, dimethyl vinyl phosphonate, dipropyl vinyl phosphonate, ethylene glycol methacrylate phosphate ($CH_2=C(CH_3)CO_2CH_2CH_2OP(O)(OH)_2$), allyl diethylphosphonoacetate $(C_2H_5O)_2P(O)CH_2CO_2CH_2CH=CH_2$), triethyl 3-methyl-4-phosphonocrotonate $(C_2H_5O)_2P(O)CH_2C(CH_3)=CHCO_2C_2H_5$), and allyl tetraisopropylphosphorodiamidite ($[[CH_3)_2CH]_2N]_2POCH_2CH=CH_2$).

13. The lithium secondary battery according to claim 11, wherein the linear polymer having P=O bonds is present in an amount ranging from about 0.005 to about 5 wt% based on the total amount of the electrolyte.

14. A method of manufacturing a lithium secondary battery, comprising:

preparing a lithium secondary battery by injecting a non-aqueous electrolyte comprising a lithium salt, a non-aqueous organic solvent, a phosphonate compound with an unsaturated hydrocarbon group, and a polymerization initiator between positive and negative electrodes; and

reacting the phosphonate compound with the unsaturated hydrocarbon group to prepare a linear polymer with P=O bonds.

15. The method according to claim 15, wherein the method further comprises heat-treating the manufactured lithium secondary battery.

16. The method according to claim 15, wherein the phosphonate compound with the unsaturated hydrocarbon group is at least one selected from the group consisting of diethyl vinyl phosphonate, dimethyl vinyl phosphonate, dipropyl vinyl phosphonate, ethylene glycol methacrylate phosphate ($CH_2=C(CH_3)CO_2CH_2CH_2OP(O)(OH)_2$), allyl diethylphosphonoacetate ($(C_2H_5O)_2P(O)CH_2CO_2CH_2CH=CH_2$), triethyl 3-methyl-4-phosphonocrotonate ($(C_2H_5O)_2P(O)CH_2C(CH_3)=CHCO_2C_2H_5$), and allyl tetraisopropylphosphorodiamidite ($[[CH_3)_2CH]_2N]_2POCH_2CH=CH_2$).